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Abstracts

Neutron beam therapy In UK.

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The first hospital-based Cyclotron was established by the Medical Research Council at the Hammersmith Hospital in the 1950s. A review of factors that lead to this will be reviewed together with an over-view of the original clinical work and trials undertaken at the Hammersmith. This will be followed by a discussion of results from the Hammersmith Hospital and Edinburgh together with other UK centres with analysis of results obtained from those different centres. Particular attention will be paid to the report of the MRC Working Group analysing the results in head and neck cancer from the Hammersmith and Edinburgh.

Finally, a report of future prospects on Neutron Beam Therapy in the UK will be given.

Clinical trial with neutron beam at the Variable Energy Cyclotron Centre

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A brief description of the Clinical aspects of the neutron therapy is discussed. Production of neutron beams, interaction of neutrons with matter, energy transfer, collimation of neutrons and other aspects are given.

Dosimetric studies of a collimated neutron beam from Be (α, Xn) neutron source

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Dosimetric studies were carried out with Be (α, Xn) neutron source, using Tissue Equivalent proportional counter and a Water phantom. Central axis depth

dose distribution and transverse-axis dose distribution were measured. The paper summarises the results obtained from these studies.

Nuclear magnetic resonance in medicine

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Nuclear Magnetic Resonance is the latest addition to the field of diagnostic imaging. It is an excitment to the radiologist, curiosity to the civilian and an ocean of in vivo Bio-chemical information to a research scientist. NMR images not only shows exquistic anatomical details but also encode Physico-Chemical information at the molecular level. Clinical Magnetic Resonance Spectroscopy is an exciting area which holds the key for more information at the bio-chemical level will help in improving the diagnosis and overall management of the patients.

Application of electromagnetic fields in medical diagnostics and therapy

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Use of magnetic field as a tool of therapy is perhaps as old as the French Revolution days, when it was both used and misused by science-minded men and charlatans alike. Gradually this 'art' was all but lost in oblivion except in a crude form (the so-called Magnetotherapy) practised largely by homeopaths. However the last decade has witnessed a comeback of magnetic field both as an agent of therapy and as a powerful diagnostic tool.

It was only during the late seventies that breakthroughs in instrument technology in Biomagnetism made it possible to measure/record static and time-varying fields as minute as one part in 100 million of earth's magnetic field (a few Pico-Teslas) through the use of the Superconducting Quantum Magnetometer (SQUID) and magnetic gradiometer. This has generated a new diagnostic technology unparalled in Biomedical Engineering, covering monitoring of foetal heart-cardiac irregularities or arrhythmias and non-invasive thoracic mapping of haemodynamic irregularities associated with cardiac pathogeny, magnetic mapping of cortical and sub-cortical current distributions in the brain for target-focussing of lesions, non-invasive biopsy for locating iron super enrichment of liver, locating microscopic contamination of lungs by ferromagnetic dust, study of phagocyte function in elimination of pollutants from lungs. A bare outline of some of these techniques will be presented.

As a tool of therapy magnetic field has staged a comeback in a new garb as pulsed magnetic field, during the last decade or so. Largely coming on the heels of the pioneering researched of 1970s on re-growth of fractured bones using implanted current electrodes, the new technology of pulsed magnetic field appears but a logical revision of thinking, namely how to send pulsed currents to the injury site non-invasively through inductive coupling of electromagnetic energy. Here a major breakthrough has been the identification of a 'response window' at the ELF end of the spectrum through the pioneering researches carried out by the Madras Institute of Magnetobiology at Madras during the early eighties. This has immediately found application as a highly successful therapy tool for handling a variety of pathogenies like spondylosis, arthritis, sports trauma, diabetic ulcers and a few others. This new and emerging technology will be described briefly.

Current status of the dosimetry of potential therapeutic low energy electron emitting radionuclides.

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Eversince the discovery of radioactivity, particularly after the discovery of the artificial radioactivity and production of radionuclides by accelerators and reactors, attempts are on to use the radionuclides for radiotherapy. With the advent of better tumor specific radiopharmaceuticals, immunochemicals, monoclonal antibodies the goal of a tumor specific radiotherapeutic radionuclide seems more nearer. It requires detailed dosimetric computations not only to compute the target dose but also to identify the non-target critical organ, dose to which could be a limiting factor in the use of that therapeutic agent. The present paper reviews the current status of the dosimetry of the low energy electron emitters with emphasis on Auger electron emitters. The two important methodologies of dosimetry, namely, the one of obtaining average absorbed dose to either a macroscopic or a microscopic target and the other of obtaining the exact energy deposition in microtargets by detailed Monte Carlo computations have been discussed. Detailed considerations of the radionuclide decay through Auger and Coster-kronig transitions resulting in the emission of copious low energy electrons ; and their energy deposition characteristic in targets of defined shape and size of relevance in radiobiology and radiotherapy have been presented in the review to enable appropriate dosimetry of these radionuclides at all levels of biological organization.

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Flow cytometry in biology and medicine.

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Life Sciences as a discipline is moving rapidly and it is safe to predict it is going to an exciting area of research for the remaining part of this century and thereafter comparable to the excitment in physics during the first half of this Century. Some of the Techniques earlier used Beta and Gamma Ray spectroscopy were applied to study the complexity of individual cells. These techniques permit classification and isolation of cells and individual chromosomes at the rates upto 20,000 cells or chromosomes per second. Los Alamos National Laboratory is one of the major centres that pioneered this instrumentation commonly known as flow cytometry. The basic principles of this instrumentation and its application in Biology and Medicine including immunology will be presented.

Photodynamic therapy—a new modality for the treatment of cancer

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Progress in photobiology research during the last decade has led to the development of Photodynamic Therapy (PDT) of tumors, a new promising modality for the management of cancer. PDT involves administration of a photosensitizer, which preferentially accumulates in the tumor, followed by photo-irradiation to induce cytotoxicity. Advances in lasers, fibre-optic and endoscope technology have made photo-irradiation of even deep seated tumors possible. Clinical studies to investigate efficacy of PDT using a haemetoporphyrin derivative (Hpd) have yielded encouraging results in patients suffering from various types of tumors, for example, in the lung, breast, bladder, skin, brain and eye. Side effects associated with the skin photosensitization have been observed, which make it necessary that the patients are kept in the dark for a few weeks. Efforts are now being made to improve PDT further by using synthetic dyes (such as pthatocyanins), designing better light delivery systems and by combining PDT with other treatment modalities such as hyperthermia and radiochemotherapy.

The mechanisms involved in the preferential tumor accumulation of the dye and the processes responsible for photosensitization leading to cell death remain yet to be completely elucidated. Available evidence suggests that the primary photophysical and photochemical processes involved in the energy transfer from the excited triplet state of the photosensitizer result predominantly in the formation of

singlet oxygen, which induces irreversible oxidation of important biomolecules causing disruption of the cellular organization and function. Critical cellular organelles, such as plasma membranes, mitochondria, nucleui, microsomes, lysosomes and DNA have been implicated as sites of photodynamically induced lesions responsible for cell death. Our recent experiments suggest that Hpd induces profound changes in the pattern of cellular energy metabolism even in the absence of light. After photo-irradiation, a state of energy deficiency is induced because of severe damage to mitochondria. The energy deficit and resulting cytoxicity can be enhanced by hyperthermia, acidic environment and presence of glycolytic inhibitors such as 2-deoxy-D-glucose. The implications of these results for improving PDT will be discussed and emerging research problems will be outlined.

Purification of mammary tumor associated antigen using physicochemical methods

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Recognition of an antigen—the stimulus which provokes the body's immune respsoen under disease conditions—is a very important critertion in medical research and diagnosis. The present day wonder, monoclonal antibody, aimed at targetting specific antigens, is now widely being used in immuno-assays, immuno-histology and immuno-therapy. However, the pre-requisite to all monoclonal antibody applications in medical diagnosis and therapy is availability of a pure antigen against which it is to be developed. Hence the purification of a disease-associated antigen is of great importance. Using physico-chemical methods, we have recently purified a mammary tumor associated antigen from murino mammary of C3H/Jax mice. Ion-exchange column chromatography using DEAE—cellulose followed by polyacrylamide gel electryphoresis was used. This mammary tumor associated antigen (MTAA) has been demonsted by us to be diagnostic and prognostic significance in human breast cancer. The present paper details the procedure by which the antigen was purified and the characterization of the antigen by physico-chemical methods such as density gradient centrifugation, SDS-gel electrophoresis and temperature and pH sensitivity.

Squids in bio-medical research.

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Among the several advanced physical techniques that are under development as diagnostic tools for medical applications, the superconducting quantum inter-

ference device (acronym squid) occupies an important position. This is on account of its unparalleled sensitivity which enables it to detect the Tiny Magnetic Fluctuations emanating from the human brain due to Bio Electric Currents. The technique is non invasive and has a fast time response. Several experiments in Magnetoencephelography have revealed the potential of Squid Magnetometers in the location of sources of intracranial activity in response to external stimuli and for the investigation of focal epilepsy. The talk will briefly discuss the physical basis of this technique and review applications in several areas of Biomagnetism. The complexity of the experimental arrangement on account of the necessity to use liquid helium will be pointed out. The possible impact, consequent to the discovery of the high temperature superconductors in bringing about more widespread applications will be discussed.

Principles of CT scan and its application in medicine.

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Computerised axial tomography is a form of high voltage X-ray which has revolutionised the medical diagnostic procedure. Sectional pictures taken of the various organs allow the diagnosis structural abnormalities.

Principles of isotope imaging and its application in medicine.

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It is a technique which makes the use of tracer principle in Clinical Medicine and Biomedical research for the quantitative assessment of functioning of various organs.

Principles of ultrasonography and its application in medicine

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Diagnostic ultrasound is non-invasive technique, which utilizes high frequency sound waves and its returning echoes to demonstrate the various organs and their abnormalities.

Detection of electrical signals and its biomedical application

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It is possible to detect various electrical signals from different parts of the body. The singals from the brain, nerves, muscles, may be used to diagnose various neurological abnormalities through EEG, EMG and evoked potential studies.

Basic principles of fibre-optic endoscopy and its application in medicine

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Endoscopy, to see within, has revolutionised the diagnosis and management of various diseases affecting the different parts of the body. The simple principle of treatment of light in a glass rod has led to the development of fibre-optic endoscopy.

Basic principles of GI manometry and its application in medicine

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Pressure studies of the different parts of the GI tract are now possible with various sophisticated transducers and these help in the diagnosis of various medical problems. Conversion of pressure variations into electrical signals has made this advancement possible.